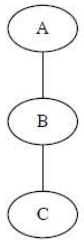
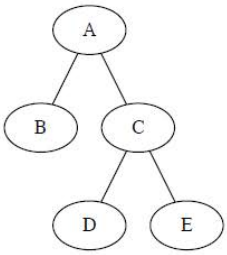
# CIND830
# Python Programming for Data Science
# Lab 10 - Questions

## 1 Binary Tree Implementations

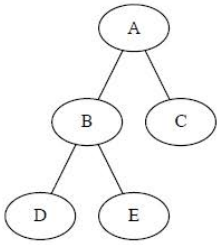
Given the following four binary trees:



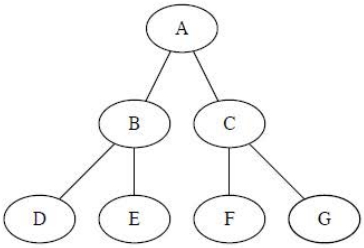

Unbalanced BT




Perfectly Balanced BT




Complete BT




Full BT

**a.** List the values of the properties of each tree according to the following table.

| Property | Unbalanced Binary Tree | Perfectly Balanced Binary Tree | Complete Binary Tree | Full Binary Tree |
|---|---|---|---|---|
| Number of nodes | | | | |
| Height | | | | |
| Root node | | | | |
| Leaves | | | | |
| Interior nodes | | | | |
| Nodes at level 2 | | | | |
| Ancestors of node D | | | | |
| Descendants of node B | | | | |

**b.** List the difference between the complete binary tree and the perfectly balanced binary tree.

**c.** List the difference between the full binary tree and the complete binary tree.

**d.** How many nodes does each of the following binary trees contain?

**i.** A complete binary tree with a height equal to 3.

**ii.** A full binary tree with a height equal to 99.

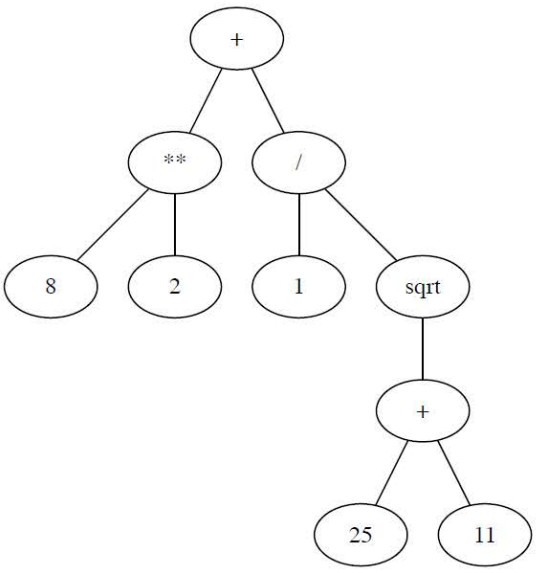
**e.** What is the height of each of the following full binary trees?

**i.** A full binary tree with 15 nodes.

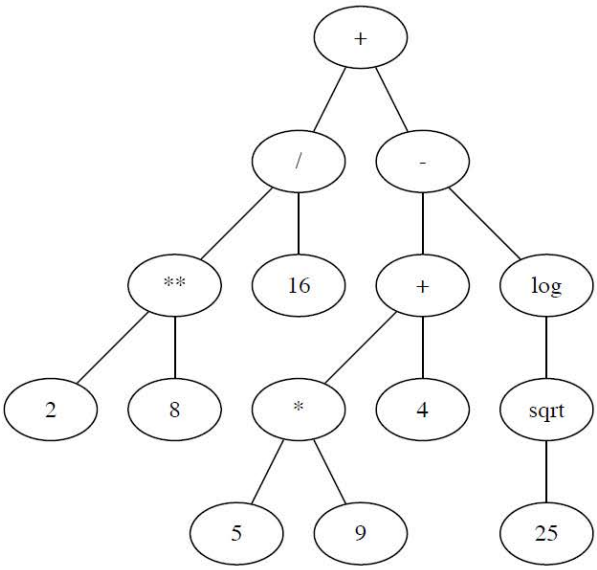
**ii.** A full binary tree with 31 nodes.

## 2 Binary Tree Applications and Traversals

**a.** Write the corresponding arithmetic expression of each of the following binary trees:




First Binary Tree




Second Binary Tree

**b.** Given the following pre-order traversal algorithm that visits the root node, then traverses the left subtree and the right subtree similarly.

```
Algorithm preOrderBT(Tree, Root):
    Visit the node at position 'Root'
    for 'Child' in 'Tree.children(Root)':
        preOrderBT(Tree, Child)
```

Write down the visited nodes' sequence if we apply that algorithm on the binary trees in question 1a.

**c.** Given the following post-order traversal algorithm that can be viewed as the opposite of the pre-order traversal algorithm.

```
Algorithm postOrderBT(Tree, Root):
    for 'Child' in 'Tree.children(Root)':
        postOrderBT(Tree, Child)
    Visit the node at position 'Root'
```

Write down the visited nodes' sequence if we apply that algorithm on the full binary tree in question 1a.

**d.** In pseudo-code, describe an algorithm that visits the nodes of the binary trees in question 2a to form the corresponding arithmetic expression. Then show the traversal paths that will be taken upon applying that algorithm on those binary trees.

This is the end of lab 10
Tamer Abdou, PhD